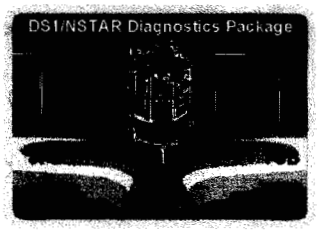


JPL TRW

NMP DS1 FACT SHEET

NSTAR

IPS Diagnostic Sensors (IDS)

INSTITUT FÜR GEOPHYSIK UND METEOROLOGIE IGM TU BRAUNSCHWEIG

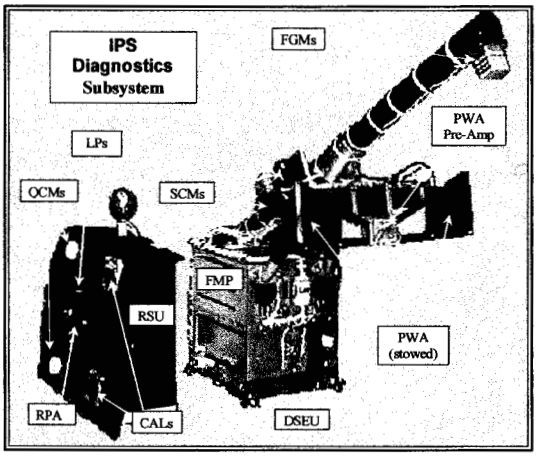
NASA

Goal

Understand the *in-situ* (local) environment of a spacecraft using an ion propulsion system (IPS).

Approach

- Perform ground and spaceflight measurements of the following critical IPS environmental factors:
  - Plasma, contamination
  - AC/ DC electric, magnetic fields
- Develop & validate predictive models for future ion propulsion missions



Instrument Description

12 environmental sensors in two interconnected units: (Mass: 8 kg, Power: 21W)

Remote Sensors Unit (RSU):

Plasma: 2 Langmuir Probes(LPs), Retarding Potential Analyzer (RPA)
Contamination: 2 Quartz Crystal Microbalances (QCMs), 2 Calorimeters (CALs)

Diagnostic Sensors Electronics Unit/Fields Measurement Processor (DSEU/FMP):

Electrostatic Fields: 2-m dipole Plasma Wave Antenna (PWA) with pre-amplifier
Electromagnetic Waves: 2 Search Coil Magnetometers (SCMs); 1 failed
DC Magnetic Fields: 2 ea. 3-axis Flux-Gate Magnetometers (FGMs)

IDS Partners:

Jet Propulsion Laboratory:	Systems Engineering, FMP, PWA, SCM, Structure, I&T, Mission Operations
Physical Sciences, Inc.:	DSEU Electronics, Calorimeters
Maxwell Technologies:	Plume modeling
QCM Research:	Quartz Crystal Microbalances
Technical University of Braunschweig:	Flux-Gate Magnetometers
TRW:	Plasma Wave Spectrometer, Pre-amp

Sensor Specifications:

Sensor	Measurement	Range	Resolution
QCMs	Mass/area	0 to 500 $\mu g/cm^2$	0.005 $\mu g/cm^2$
CALs	Solar Absorptance (α)	α = 0.08 (BOL) to 0.99	$\Delta\alpha$ = 0.01
	Hemi. Emittance (ε)	ε = 0.05 to 0.85 (BOL)	$\Delta\varepsilon$ = 0.01
LPs	Probe Current	I =-0.4 to 40 mA	1%
	Probe Voltage	V = -11 to +11 VDC	1%
RPA	Current (Gain Select)	I = 0.01, 1, 10, 100μA	1%
	Grid Bias Voltage	V = 0 to +100 VDC	0.4V
PWA	E-field (Adjust. Gain)	50 to 160 dBμV/m	± 3 dBμV/m
	24 Freq. Channels *	10 Hz to 30 MHz (4/decade)	± 40% (-3dB)
SCM	B-field (Adjust. Gain)	80 to 160 dBpT	± 3 dBpT
	16 Freq. Channels *	10 Hz to 100 kHz (4/decade)	± 40% (-3dB)
FGMs	Magnetic Field Vector **	±25,000 nT	0.5 nT

* 20 kHz waveform capture (1 sec)
** 20 Hz B-vector waveform capture (up to 55 sec)

Programmatic:

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Key Findings:

- IPS plasma drives DS1 chassis –6 to –10V with respect to solar wind "ground"
  - Chamber tests can permit electrical "short" between chassis and IPS plume potentials
- Line-of-sight contamination from IPS molybdenum grids comparable to ground measurement
- Plasma waves <120 dBμV/m, IPS transients comparable to DS1 hydrazine thruster events
- IPS permanent magnetic field vs temperature determined, field stability not yet verified (Jan.'00)